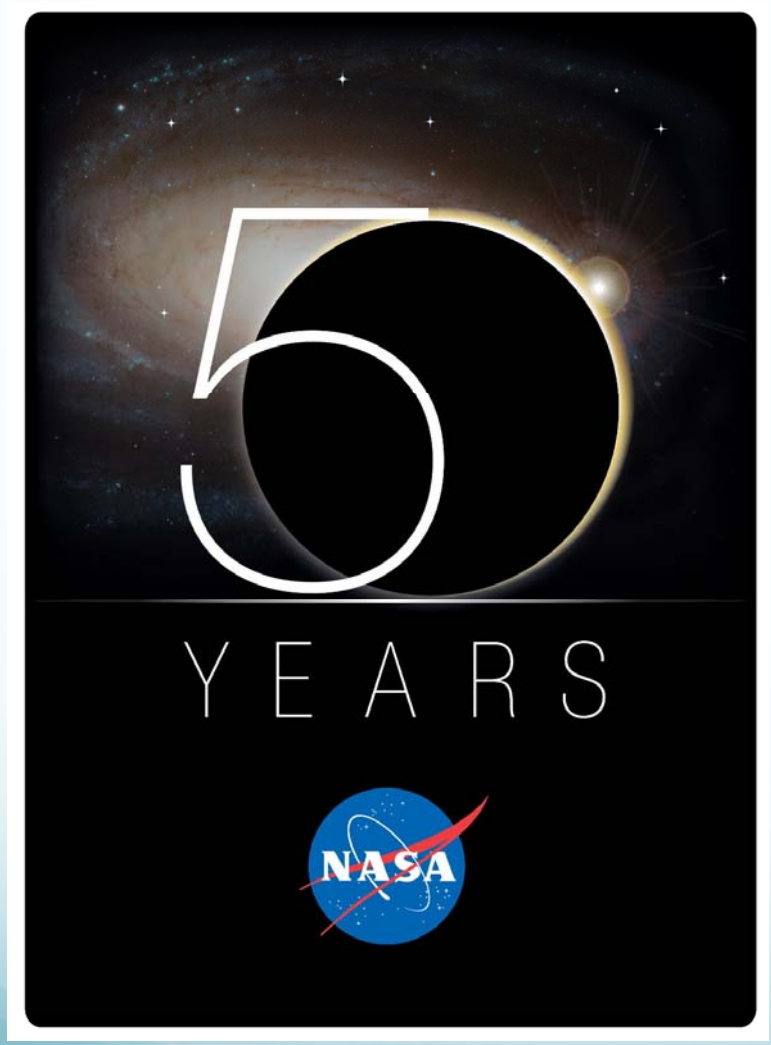
Socializing in Mixed Reality

Jeanne Holm, Tom Soderstrom, and Charles White
NASA/Jet Propulsion Laboratory
California Institute of Technology

“Reality is nothing but an illusion...
albeit a persistent one” -Albert Einstein

NASA's "birthday" is October 1, 1958



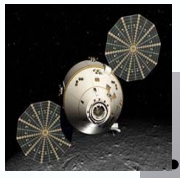
NASA's mission is to pioneer the future in space exploration, scientific discovery and aeronautics research.

KM Pain Points for NASA

Geographically Dispersed

- 10 centers in 8 states plus many other facilities
- 18,722 civil service[1]; 43,500 contractors/others[2]
- Constellation Program work is shared across all NASA centers

[1] As of August 2008, http://wicn.nssc.nasa.gov/
[2] Data as of June 2006, FAIR 2006



Aging Workforce

- Long duration projects mean a high probability of team turnover
- Ave age[1]=46.4
- Ave federal service[1]= 17.9 years
- Eligible for Retirement[1] in '07=328

[1] For civil servants only, http://wicn.nssc.nasa.gov/

Mission Transition

- Focus from Shuttle to Constellation means changes to buildings, workforce, contractors, and budget
- A 4 year gap between programs too!

Generations Share Differently

- 1930-50's era generation
  - Focus on society
  - Friendships are forged through adversity

- 1960-70's era generation
  - Focus on community
  - Friendships forged through identification with a cause

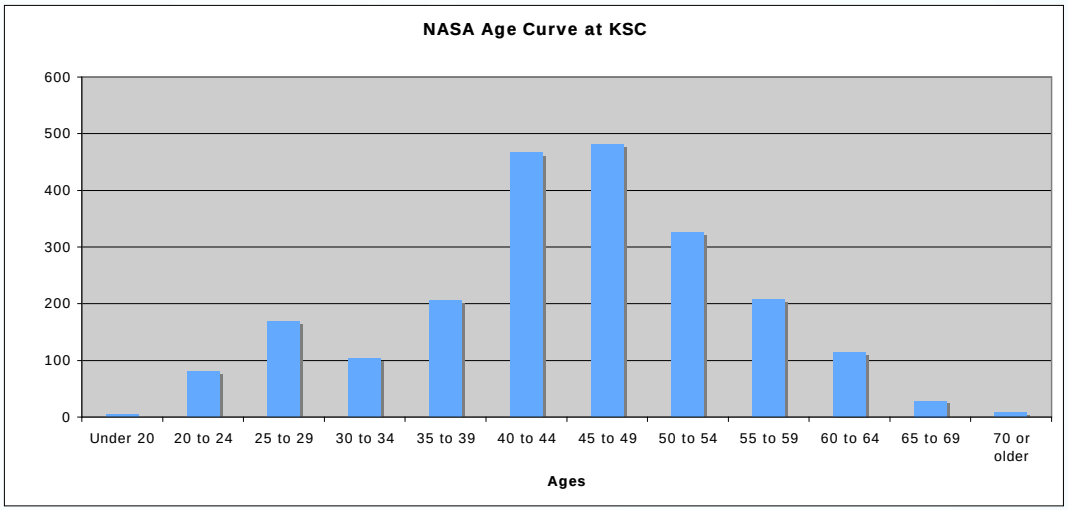
- 1980-90's era generation
  - Focus on the individual
  - Friendships forged through individual goal accomplishment
- 2000's era generation
  - Focus on common interests
  - Friendships are created or thrive virtually…

- This leads us to the need to share across generations and communicate in different modalities

Sample: KSC Workforce History and Projections

Average aged worker in Apollo days was 27!

Less than 2% of current NASA KSC employees in technical, science and engineering disciplines worked on the Apollo Program.



Estimated NASA KSC Civil Servant Knowledge Loss Risk

Year	Averge Losses	Knowledge Lost (Months)	Knowledge Lost (Years)	Knowledge Per Person
2009	95.48	21555.48	1796.29	18.81325932
2010	95.54	22116.29	1843.024167	19.29060254
2011	92.79	22084.35	1840.3625	19.8336297
2012	89.93	22104.31	1842.025833	20.48288484
2013	89.63	22912.84	1909.403333	21.3031723
2014	88.45	23228.05	1935.670833	21.88435086
2015	86.74	23712.15	1976.0125	22.78086811
Total	638.56	157713.47	13142.78917	20.58191739

KSC could experience post-Shuttle contractor workforce losses of 20-45%, based on TBD future requirements.

Creating an Opportunity

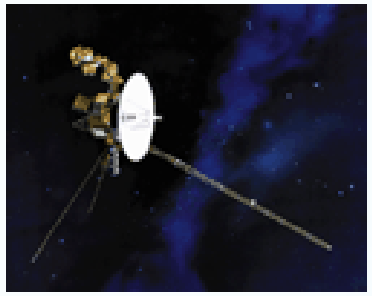
- *Knowledge management activities provide the chance to look across an organization, regardless of boundaries, and find opportunities to make a difference…*

NASA's Knowledge Management goal

Knowledge management is getting the right information to the right people at the right time, and helping people create knowledge and share *and act upon information in ways that will measurably improve the performance of an organization and its partners*

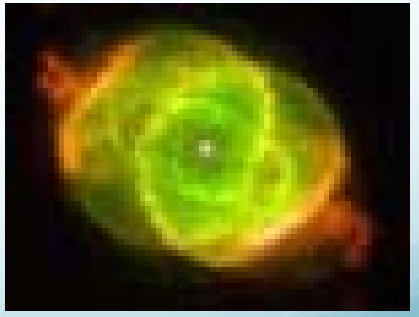
Key Areas for NASA's KM Strategy

Sustain NASA's knowledge across missions and generations to identify and capture the information that exists across the Agency



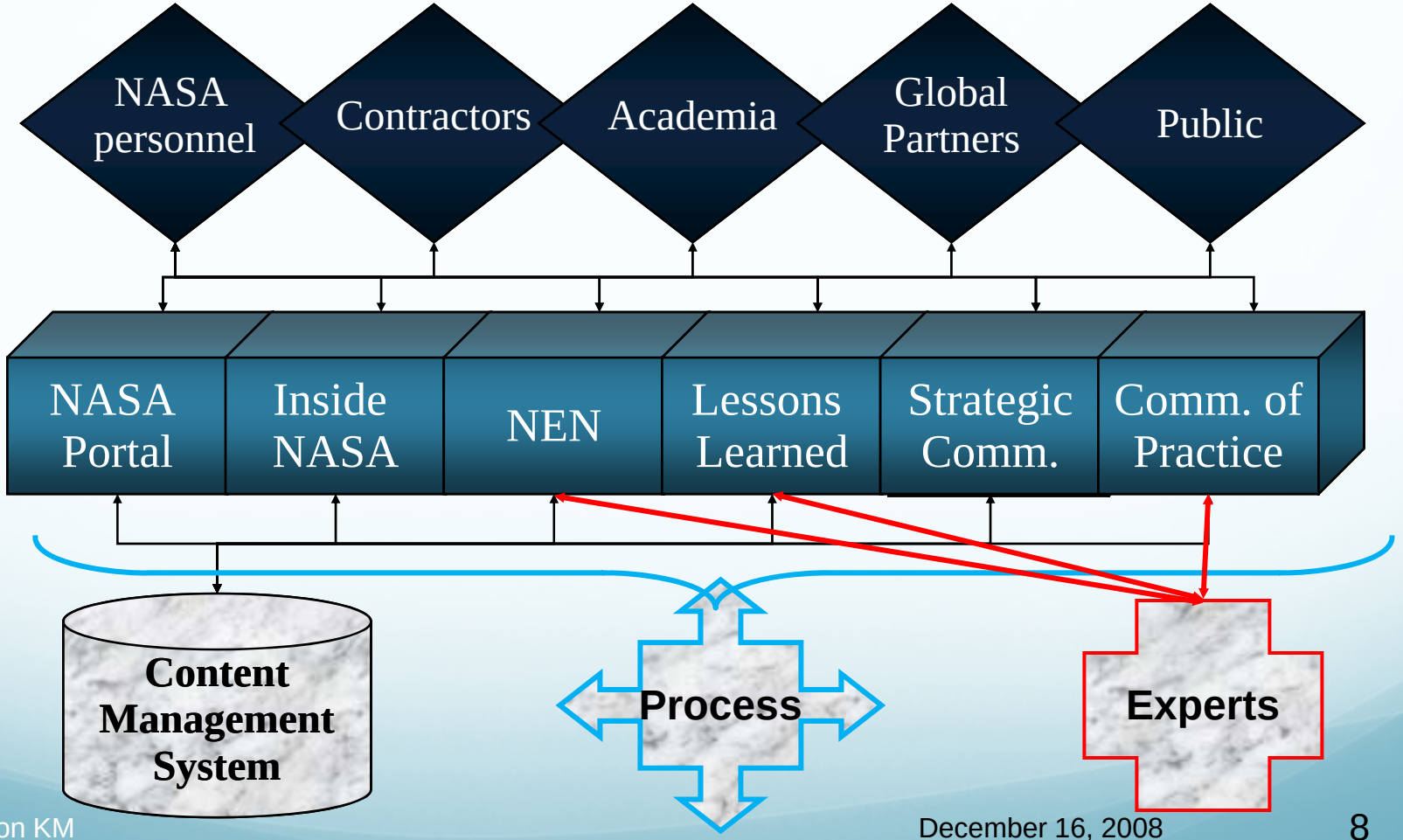
Help people find, organize, and share the knowledge we already have to efficiently manage NASA's knowledge resources

Increase collaboration and to facilitate knowledge creation and sharing to develop techniques and tools to enable teams and communities to collaborate across the barriers of time and space



Knowledge Management Environment

- Integrating knowledge management into our engineering and project management lifecycle



KM System Milestones

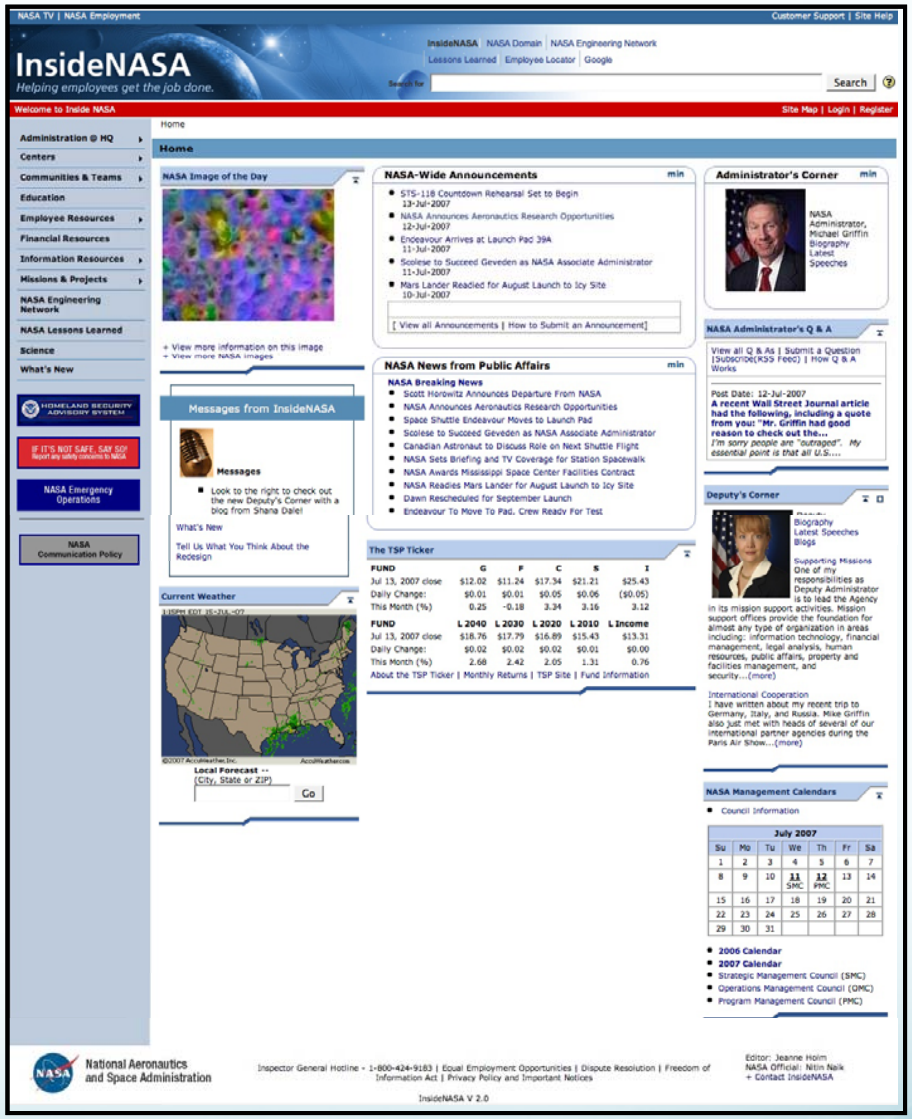
	2003	2004	2005	2006	2007
Customers	• Public • Educators	• NASA personnel	• Engineers • Project teams	• Disciplines • Communities	• Engineers and partners
Stakeholders	• CIO • Public Affairs • Education	• CIO • Strategic Communications	• Engineers • Mission directorates	• Employees • Senior management	• Scientists • Peer-to-peer collaboration
System	• NASA Portal • KM for Space (U.N.)	• InsideNASA • Research Web	• NASA Eng. Network • Emergency ops	• Communities of practice	• InsideNASA v.2 • Collab 2.0
KM Infrastructure (99.95%)	• O/S • Applications and storage • Hosting (VeriCenter)		• Caching (Akamai) and streaming • Service desk • Customization support		
Tools	• Digital Asset Management (eTouch), Vignette, Verity, Urchin	• +SunOne, WebEx, eRoom	• +NASA Xerox (NX), Jabber (instant messaging)	• +Semantic web, W3C standards, expertise locator	• +Social networking, Web 2.0, next-gen collaboration

The NASA Public Portal

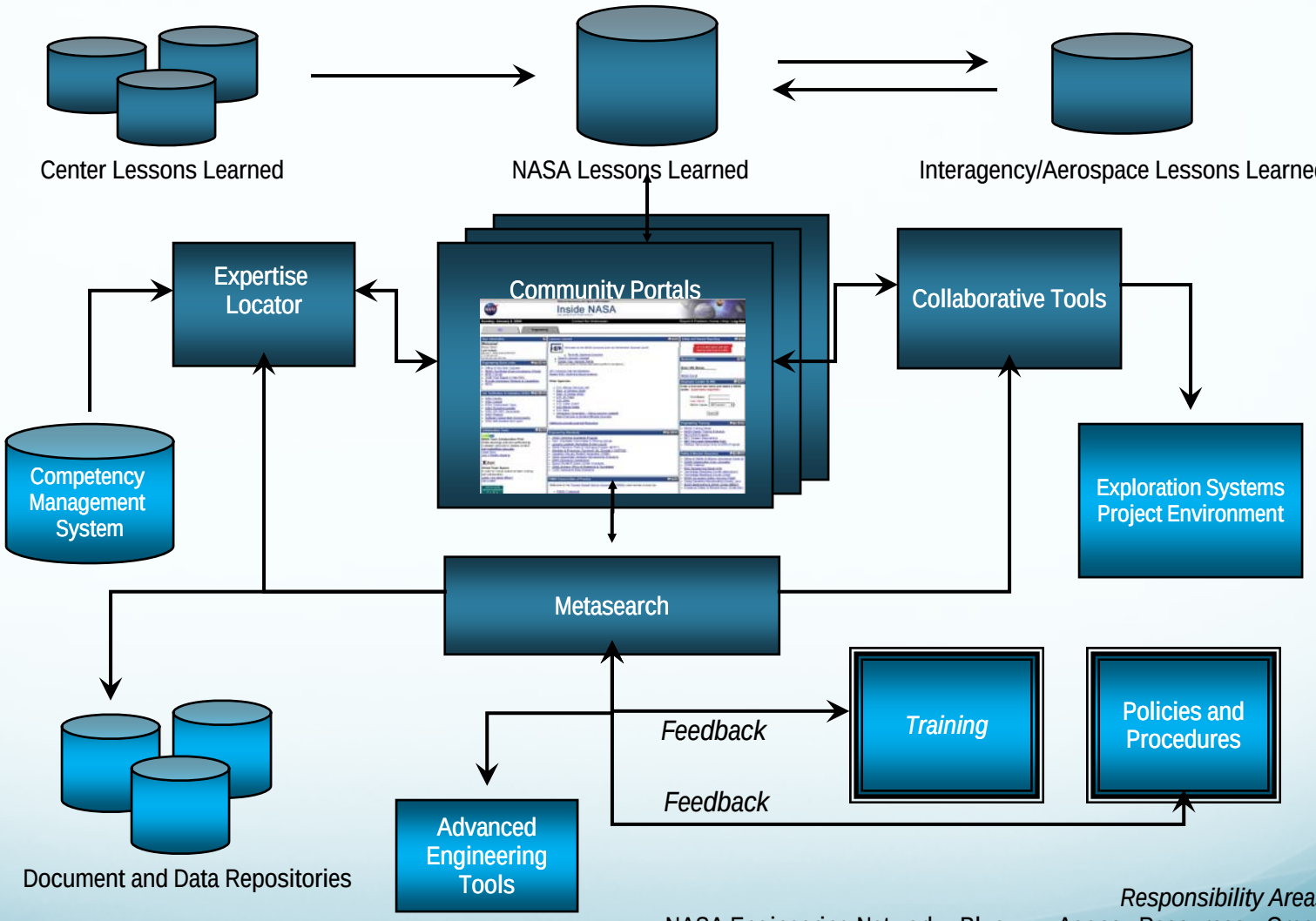
- Designed as a dramatic, interactive interface to NASA by the public, kids, media, educators, and students, integrating web resources
- Our known challenges included
  - An evolving architecture, with a 4-week deadline for deployment
    - Highly interactive and engaging
    - Content migration from top NASA sites
    - Quick and easy navigation for our many audiences
- Our unknown challenge
  - Hours after deployment, Space Shuttle Columbia tragedy would occur
  - Redesign Portal immediately and supported outreach to the public
- Landings of the Mars Exploration Rovers on the Red Planet became the largest online event to date
  - Streaming live coverage, dynamic and distributed publishing, and automatic image upload brought fresh images within minutes of the spacecraft sending
- People reached: 240 million people in 2007

Inside NASA

- For employees and partners
- Customizable
- Access to e-mail
- Secure instant messaging
- Collaborative tools
- Application integration
- Wikis and blogs (e.g. Shana Dale)
- People reached: >7500 per month accessing ~1.5M pieces of information



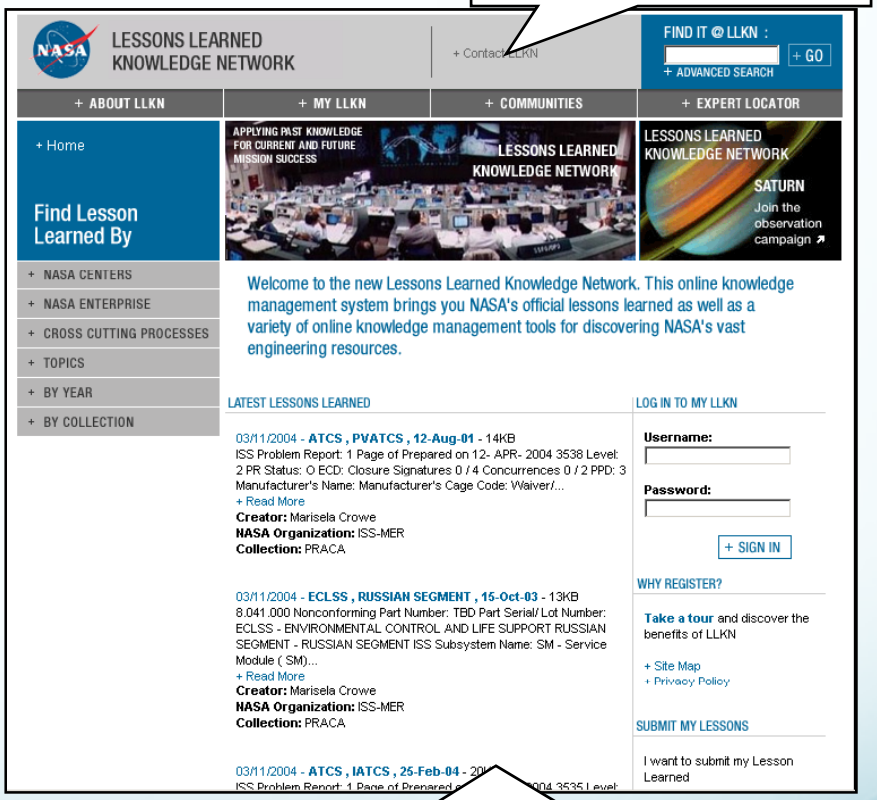
Learning occurs when people can find and share knowledge easily and act upon it



Accessing and Gathering Lessons Learned

- Formal lessons are gathered from Centers and key reviews
- Lessons are vetted and validated
- Affected policies and procedures are changed as needed
- Subscriptions allow new lessons to come just in time
- Managed by Office of Chief Engineer (NEN)
- Led by Michael Bell, NASA KSC

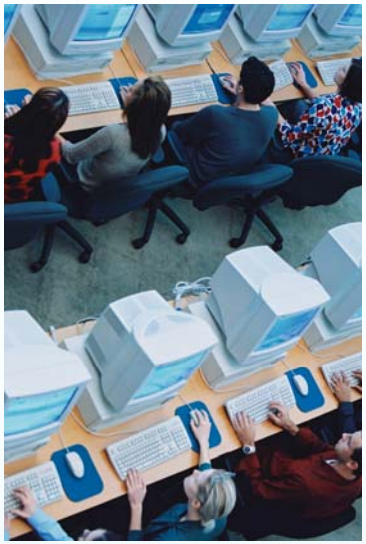
Built on same infrastructure as NASA's public Portal

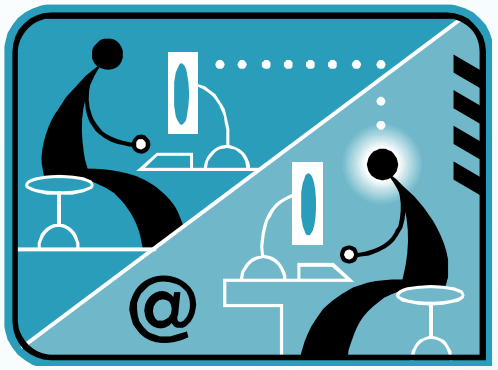


Lessons are solicited from academia, industry, and global partners

APPEL Community of Practice (Academy of Program and Project Engineering Leadership)

Class preparation





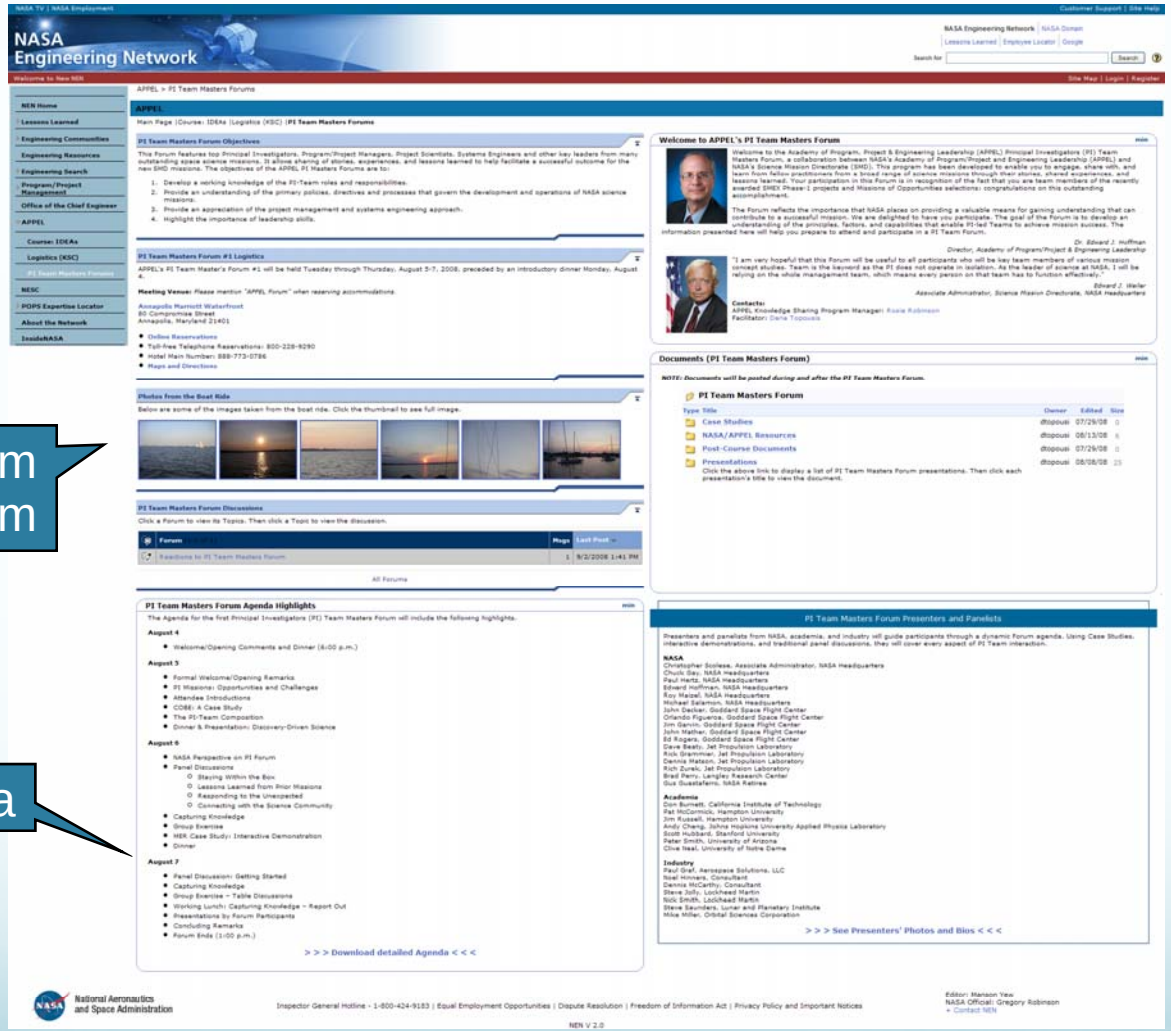
Discussions and course follow-up

Led by Dr. Ed Hoffman, NASA HQ

APPEL Community of Practice

APPEL IDEA's Course Community

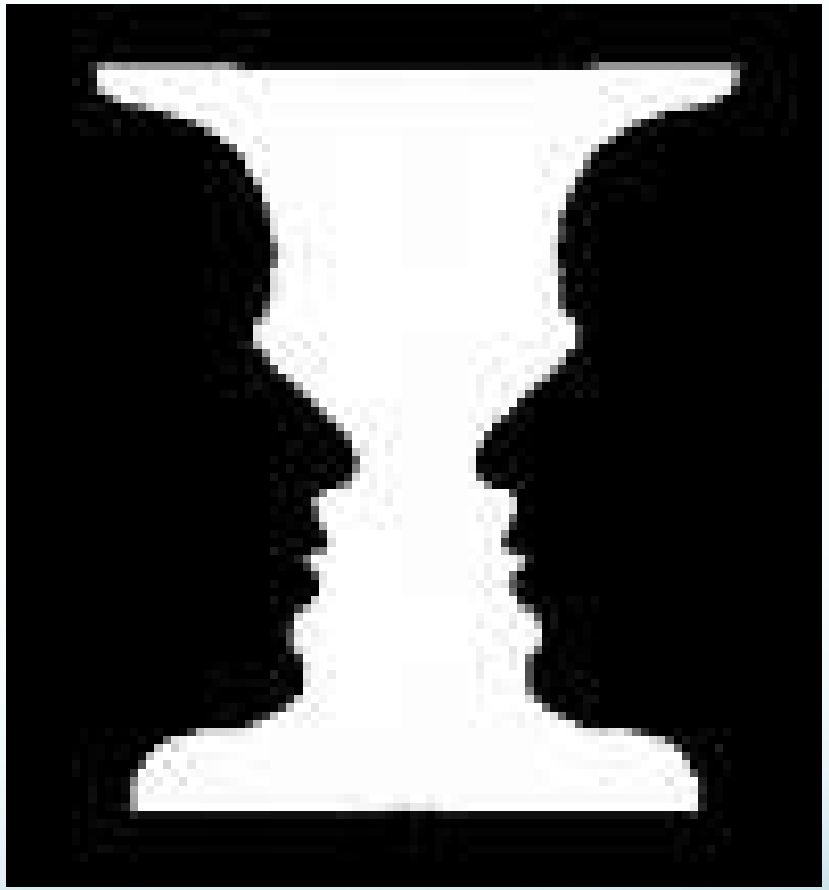
APPEL Principle Investigator Forum



Photos from the Forum

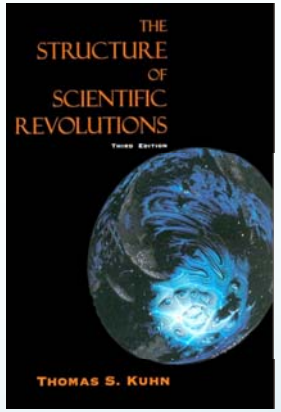
Agenda

Paradigm Shift



Defining the Competitive Edge

- One of the most powerful aspects of understanding social networks in an organization or field is to see how to connect several together
- Historically, innovation and breakthrough ideas and technologies occur at the edges and boundaries of networks
- Thomas Kuhn's *The Structure of Scientific Revolutions* describes such radical innovation as a paradigm shift
  - Astronomy: Ptolemy to Copernicus
  - Biology: Creation to Darwinian evolution
  - Politics: English monarchy to Magna Carta



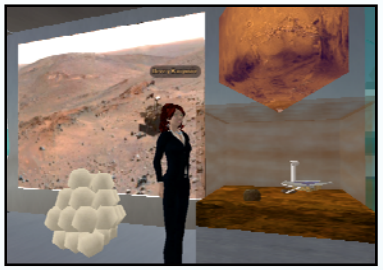
- Where will your innovation occur?
- "Networks of the Moment"
- A challenge many organizations face is how to manage the flow of critical information during a crisis, when traditional social networks are insufficient or break down

Baby Boomers to Gen X to Gen M

- Socialization now occurs primarily online for the age group 6 through 30
- As the sales of sports video games increases, the number of people watching sports decreases?
  - What does this say about how people are choosing to interact with reality? How do we take virtuality and bring people closer to the experience of space exploration?

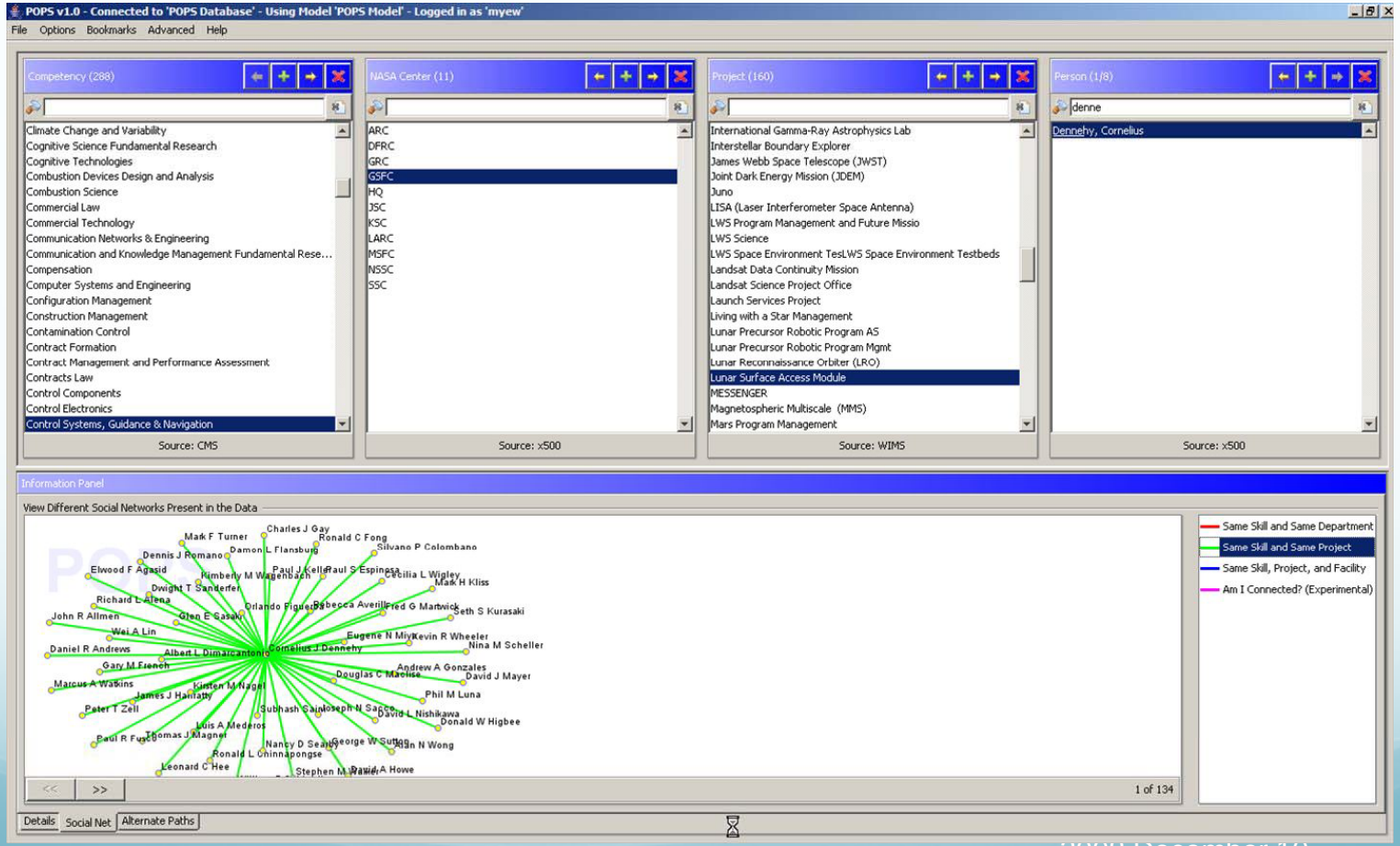
Discovering Knowledge in New Ways

- Semantic SEEK
  - Searching engineering expertise and knowledge (MIT, Sir Tim Berners-Lee)
    - Semantic query to dynamically integrate distributed content and context
    - Focusing on lunar mission data from international partners
- Explorer Island--Second Life immersive avatar-driven environment for collaboration and engineering
  - Mission support (modeling and simulation, collaboration, proposal development, and more); outreach; education; and training



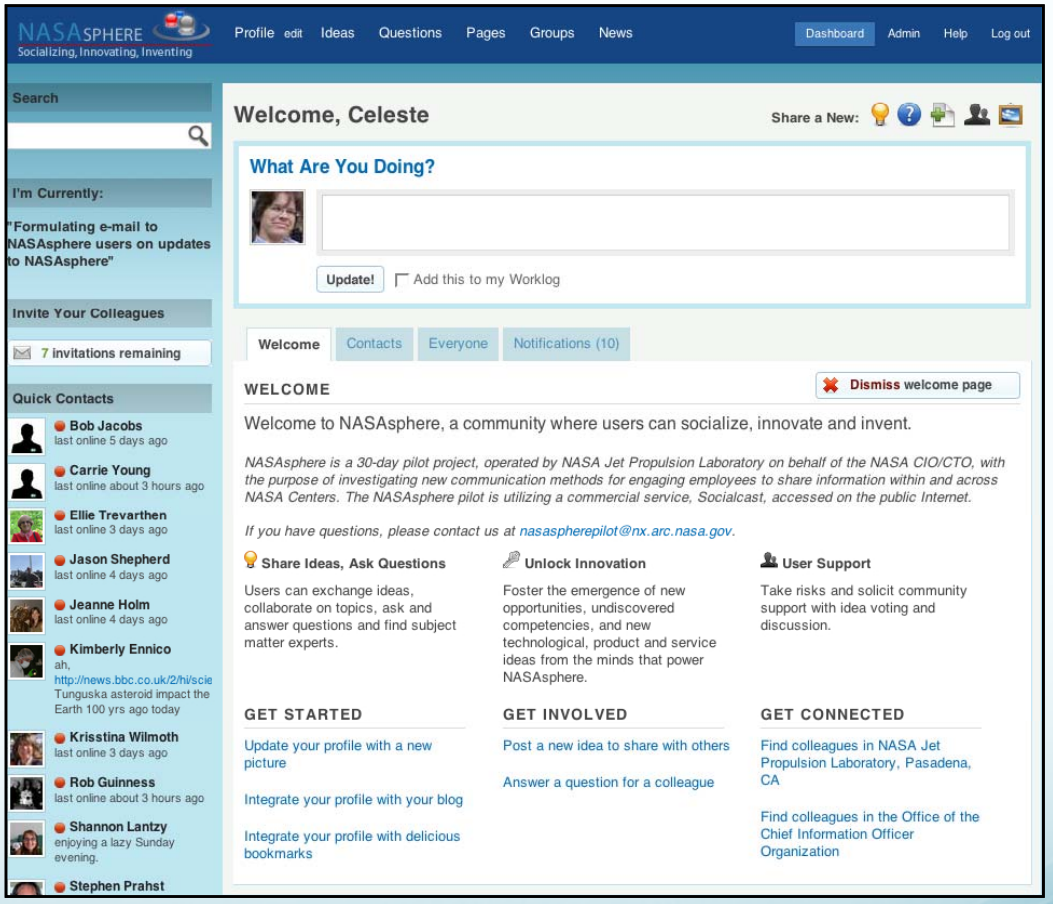
POPS Expertise Locator

- Semantic technology to find people through search and social connections
- Led by Andy Schain, NASA HQ



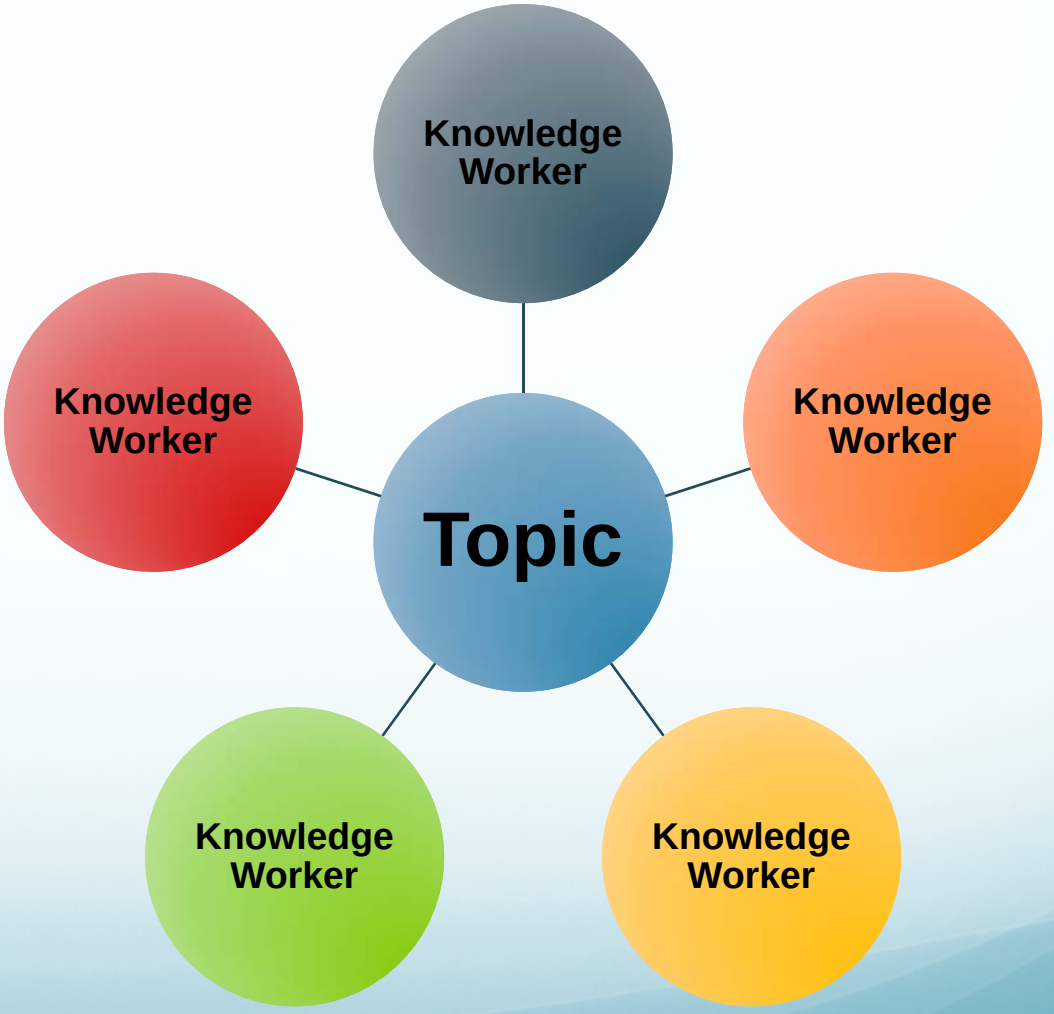
Social Networking – NASAsphere pilot

NASAsphere is online social network that enables employees to move across physical boundaries established by disparate locations of centers, to move across traditional communication boundaries established by organizations, and to move outside personal networks, in order to share and foster collective intelligence for the betterment of conducting NASA business.



Social Networking
How NASAsphere Works

"The network of a conversation spreads based on its topic rather than by person-to-person sharing." ~ NASAsphere participant



Social Networking Benefits to NASA

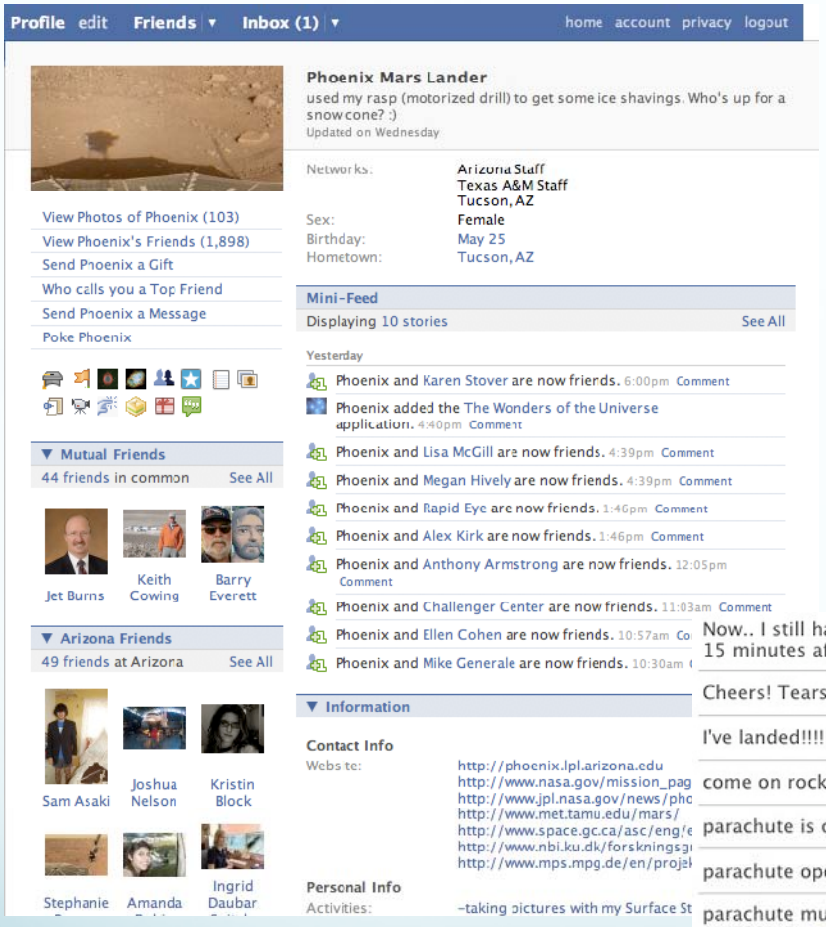
Accelerates communication and problem solving, creating peer-to-peer communication capability

Captures individual knowledge worker know-how for reuse by many, creating collective intelligence

Creates peer-to-peer communication in context, deepening understanding for decision making

Sharing the Excitement of Discovery

Creating the Basis for Transformation



Now.. I still have some other milestones ahead. Solar panels will open in 15 minutes after the dust has settled here. about 3 hours ago from web

Cheers! Tears!! I'm here! about 3 hours ago from web

I've landed!!!!!!!!!!!! about 3 hours ago from web

come on rocketssssss!!!!! about 3 hours ago from web

parachute is open!!!!! about 3 hours ago from web

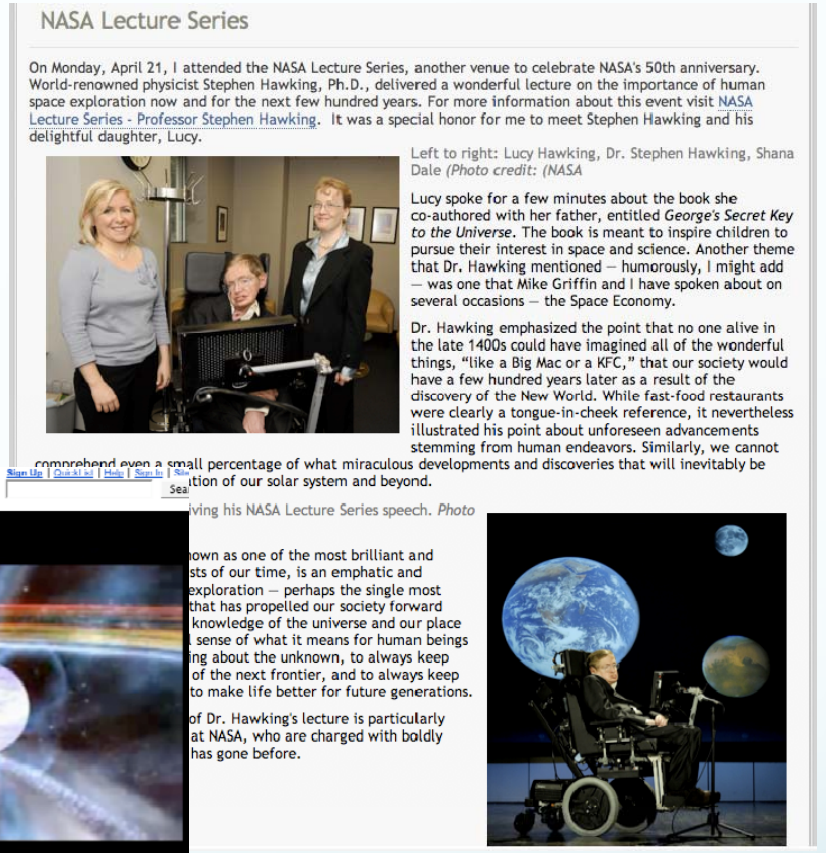
parachute opening is scariest part for the team. about 3 hours ago from web

parachute must open next. my signal still getting to Earth which is AWESOME! about 3 hours ago from web

Peak heating will hit in 40 seconds. The heat and energy generated during atmospheric entry would be enough to power 280,000 homes about 3 hours ago from web

Atmospheric entry has started. time to get REALLY nervous. Now I'm in the "seven minutes of terror." about 3 hours ago from web

Speaking Out and Speak Up



NASA Lecture Series

On Monday, April 21, I attended the NASA Lecture Series, another venue to celebrate NASA's 50th anniversary. World-renowned physicist Stephen Hawking, Ph.D., delivered a wonderful lecture on the importance of human space exploration now and for the next few hundred years. For more information about this event visit NASA Lecture Series - Professor Stephen Hawking. It was a special honor for me to meet Stephen Hawking and his delightful daughter, Lucy.

Left to right: Lucy Hawking, Dr. Stephen Hawking, Shana Dale *(Photo credit: (NASA*

Lucy spoke for a few minutes about the book she co-authored with her father, entitled *George's Secret Key to the Universe*. The book is meant to inspire children to pursue their interest in space and science. Another theme that Dr. Hawking mentioned – humorously, I might add – was one that Mike Griffin and I have spoken about on several occasions – the Space Economy.

Dr. Hawking emphasized the point that no one alive in the late 1400s could have imagined all of the wonderful things, "like a Big Mac or a KFC," that our society would have a few hundred years later as a result of the discovery of the New World. While fast-food restaurants were clearly a tongue-in-cheek reference, it nevertheless illustrated his point about unforeseen advancements stemming from human endeavors. Similarly, we cannot

comprehend even a small percentage of what miraculous developments and discoveries that will inevitably be

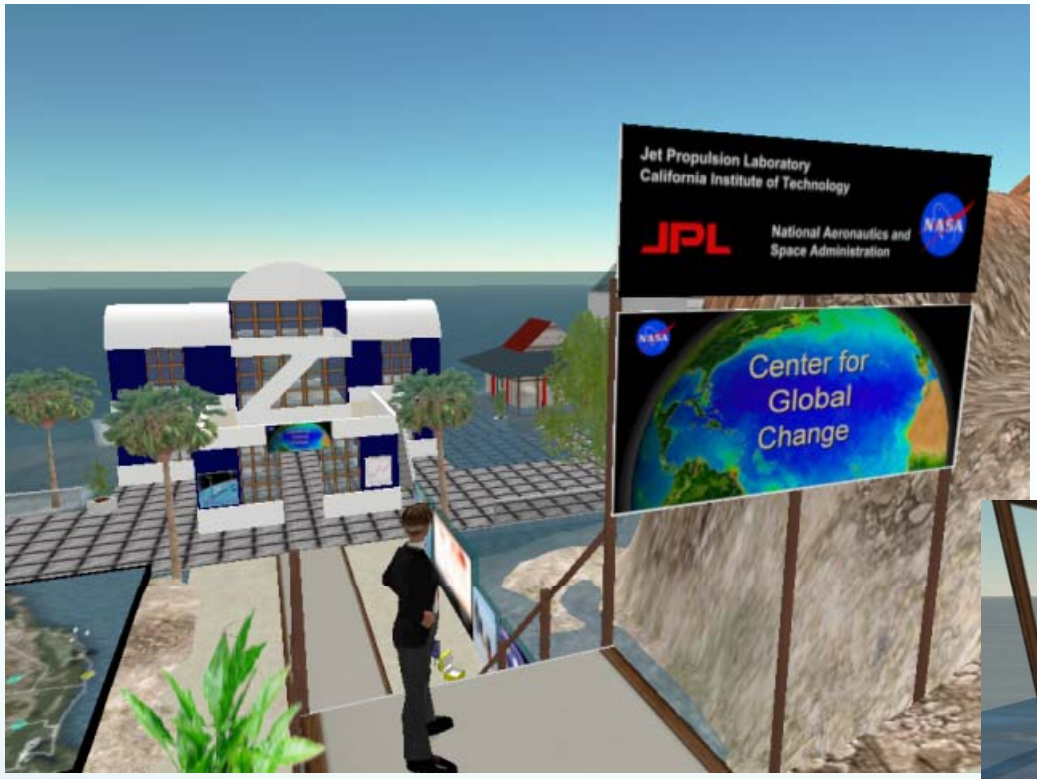
tion of our solar system and beyond.

ving his NASA Lecture Series speech. *Photo*

own as one of the most brilliant and sts of our time, is an emphatic and exploration – perhaps the single most that has propelled our society forward knowledge of the universe and our place sense of what it means for human beings ng about the unknown, to always keep of the next frontier, and to always keep to make life better for future generations.

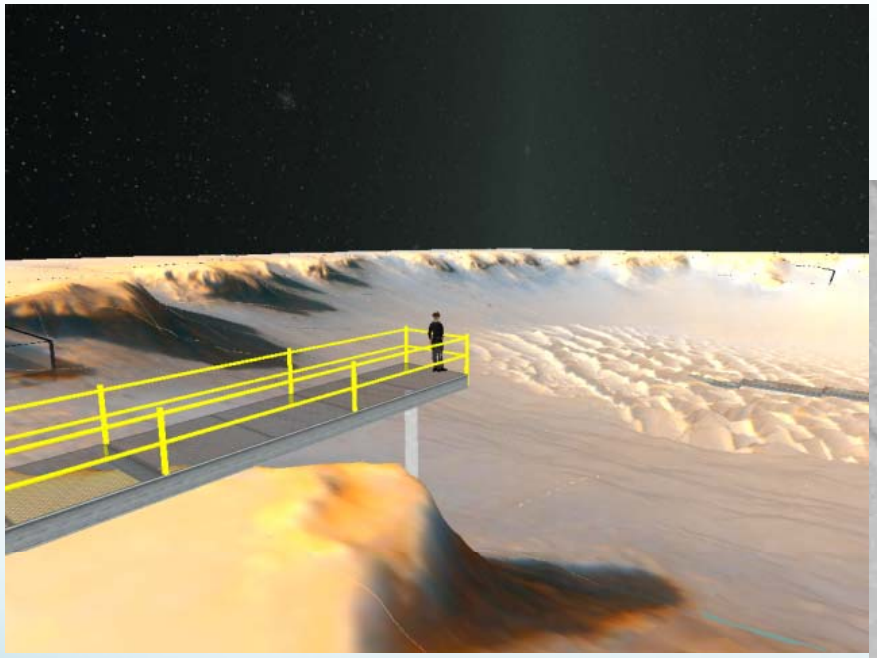
of Dr. Hawking's lecture is particularly at NASA, who are charged with boldly has gone before.

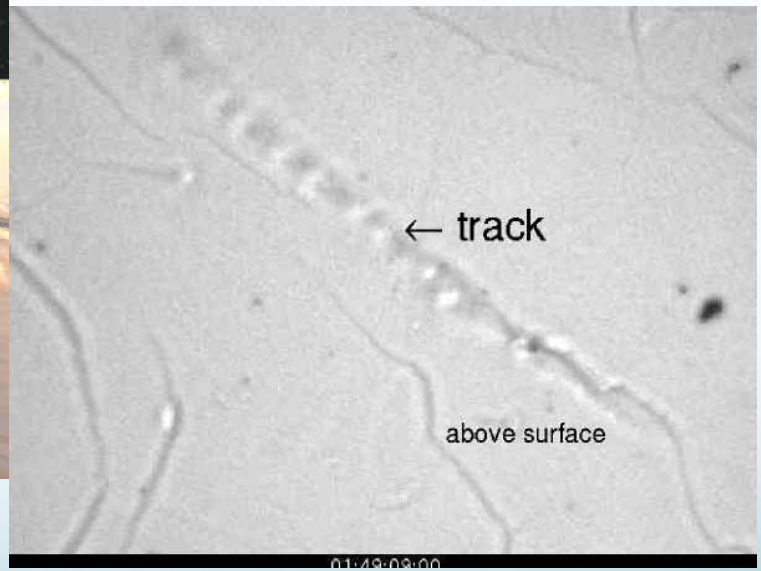
Influence = Changing Policies



Participate = Crowd Sourcing Real Science

- Being a virtual astronaut
- Searching for micrometeroids with Stardust





New Technologies in a Flight Mission (Phoenix)

Find us on Facebook

1st pix from Phoenix

Remote Face-to-Face Concept Validation for Phoenix Project

twitter

"(About 3 hours ago from web in reply to KeithCowing) - Looking forward to moving arm today. Will bend the wrist and flex the elbow. It's been stowed for 10 months so I'll move it slowly…"

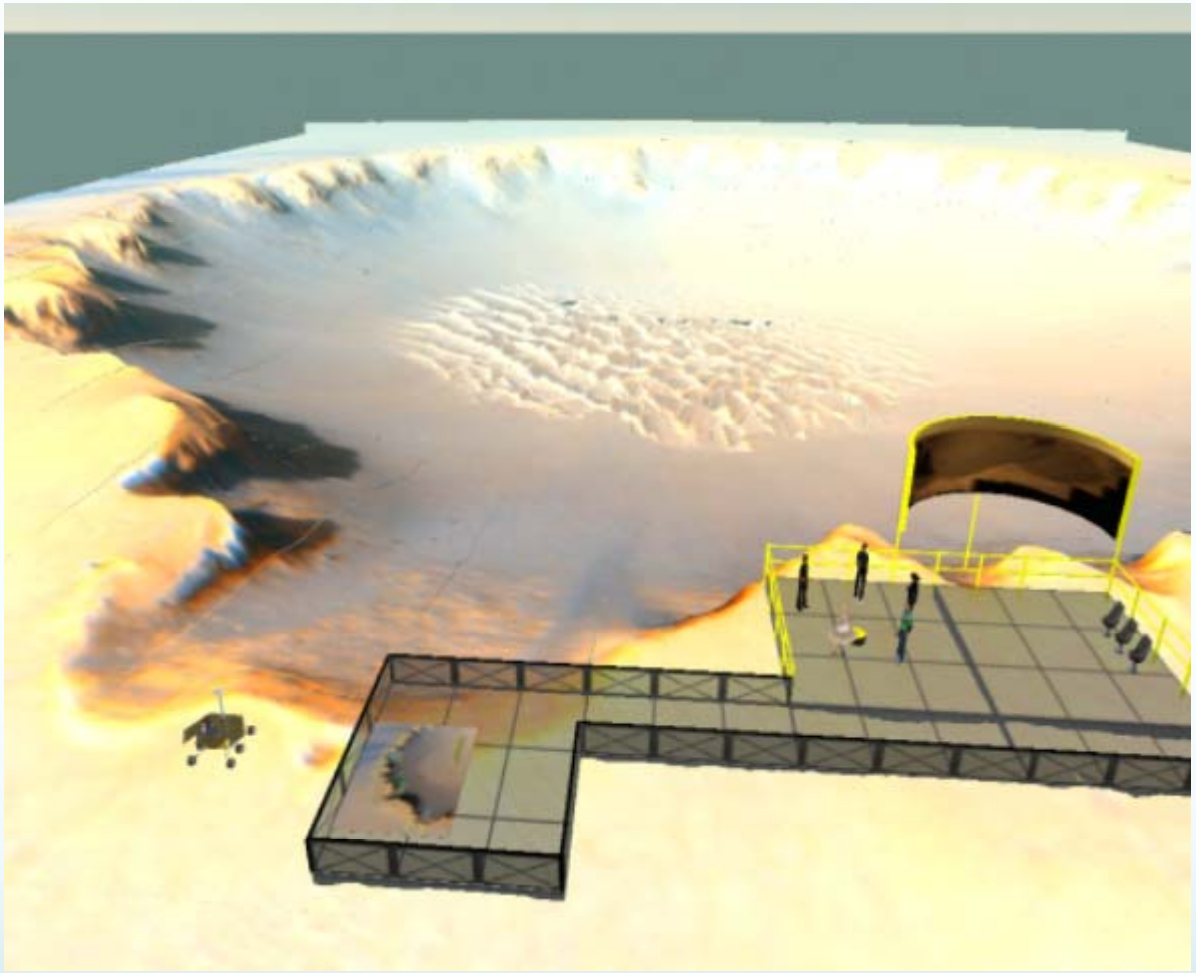
Phoenix landing in Second Life in real time

Blog

Landing Day 05.25.08
Brent Shockley 7:20 pm
I'm happy to report that we now have pictures from the spacecraft, downlinked through Mars Odyssey…

Participatory exploration of Mars Victoria Crater

Second Life History: First use of real science data to model actual location



"Excuse me... I'm crying... This is wonderful!"
-visiting avatar

Looking Ahead

- We are working on a variety of new initiatives that are still being formulated, including
  - Agency-wide knowledge architecture
    - Update structured approach to integrating knowledge for mission success
  - Accelerating learning
    - Integrate approach to e-learning and support to the project managers
  - Supporting engineering excellence
    - Drive multi-generational learning with the NASA Engineering Network
    - Facilitate communities of practice with NESC technical experts
    - Embed lessons learned into engineering practices
  - Managing knowledge for aerospace and government
    - Work with national and international organizations to benchmark and validate approaches and to learn new methods
    - Promote standards for information and data interoperability
    - Create policies that promote sharing knowledge amongst space organiations

Knowledge Management Roadmap

Sharing Knowledge

- Adaptive knowledge infrastructure is in place
- Knowledge resources identified and shared appropriately
- Timely knowledge gets to the right person to make decisions
- Intelligent tools for authoring through archiving
- Cohesive knowledge development between NASA, its partners, and customers

Enables sharing of essential knowledge to complete Agency tasks

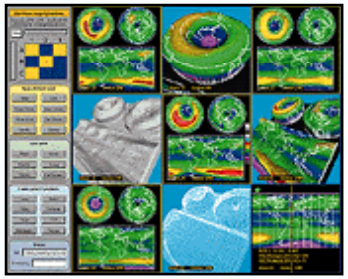
- International Space Station
- MarsNet
- Mars Exploration Rovers
- Space Interferometry Mission

Integrating Distributed Knowledge

- Instrument design is semi-automatic based on knowledge repositories
- Mission software auto-instantiates based on unique mission parameters
- KM principals are part of NASA culture and supported by layered COTS products
- Remote data management allows spacecraft to self-command

Enables seamless integration of systems throughout the world and with robotic spacecraft

- Kepler (galactic survey)
- JASON (oceanography)
- Phoenix to Mars
- Constellation Program

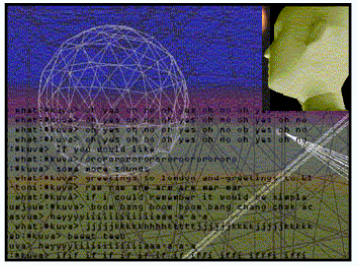


Capturing Knowledge

- Knowledge gathered anyplace from hand-held devices using standard formats on interplanetary Internet
- Expert systems on spacecraft analyze and upload data
- Autonomous agents operate across existing sensor and telemetry products
- Industry and academia supply spacecraft parts based on collaborative designs derived from NASA's knowledge system

Enables capture of knowledge at the point of origin, human or robotic, without invasive technology

- Mars robotic outposts
- Constellation Program
- Terrestrial Planet Finder



Modeling Expert Knowledge

- Systems model experts' patterns and behaviors to gather knowledge implicitly
- Seamless knowledge exchange with robotic explorers
- Planetary explorers contribute to their successor's design from experience and synthesis
- Knowledge systems collaborate with experts for new research

Enables real-time capture of tacit knowledge from experts on Earth and in permanent outposts

- Interstellar missions
- Permanent lunar and Martian colonies

2003 **2007** **2010** **2025**

Thanks!

- Many thanks to my colleagues on the NASA KM Team who contributed to these ideas and to the excellent work they are doing in implementing knowledge management solutions at NASA
- If you have any additional questions, contact me
  - Jeanne.Holm@jpl.nasa.gov (818) 354-8282
- More information can be found about
  - NASA's KM program: http://km.nasa.gov
  - NASA's portal: http://www.nasa.gov